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Bio

Tom Bett has 40 years' experience at AWE on the design, operation and development of high power glass laser systems for high energy density plasma generation. He currently leads the operation of the Orion laser facility. He has served for over 8 years as AWE Senior Laser Authority leading a team of 12 LSO's with specialized knowledge of lasers in their specific directorates.

Abstract

Control of Multi-Fibre Output Diagnostic Lasers (T H Bett, D A Egan, G J White)

Laser based techniques are proving the best method to measure displacements and velocities of surfaces driven by shock or other impact phenomena relevant to nuclear weapon research. Following initial development from DOE laboratories they have been taken up and used extensively at AWE and also in collaborative experiments with the DOE labs.

Photonic Displacement Interferometry, PDI, is proving optimum for measurement of small displacements of surfaces that have been driven by thermo-mechanical effects including x-ray energy deposition. PDV, Photon Doppler Velocimetry or possibly more precisely HetV, Hetereodyne Velocimetry is best suited to measure higher velocity surfaces from explosively and other shock driven surfaces.

In either case, the output of a source laser is split into a reference beam and a test beam which reflected from the moving surface. The beams are then re-combined in an interferometer and analysis of the inteferogram yields surface velocity and displacement data as a function of time. A convenient way to deliver the beams is through optical fibres. The wavelength of choice due to the availability of components from the optical communications industry is generally 1550nm and the beams are delivered through single mode fibres. The systems have developed with multiple fibre outputs that can give spatial as well as temporal data.

A single fibre output does not represent a significant hazard but multiple fibre systems require Class 4 lasers as a source. They represent unique systems, with relatively low risk outputs from a single fibre, but the multiple fibre combination can be well above the MPE. The laser source can often be in a separate laboratory from the point of use and bulkhead feed-throughs may be used with potential for fibres to be uncoupled and a beam propagate into space. Furthermore, the lasers breakout of the fibre into space prior to focusing onto the test surface.

The standards dictate the engineering control measures to be put in place for a Class 4 laser. These systems pose some unique problems and the rigorous controls for Class 4 lasers may be unnecessary provided that a suitable and sufficient risk assessment can be carried out for the process. A risk assessment technique will be described here to identify the hazards and the control measures put in place to mitigate the risk of use of such widely used systems.